Mechanical Engineering 300 -

Engineering Thermodynamics I

Spring Semester 2008

Section 1, M, W, F, 10:10 AM – 11 AM,135 Reber Building

Section 3, M, W, F, 1:25 PM – 2:15 PM,135 Reber Building

Instructor: Professor Gary L. Catchen

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Office hours:
Mondays, 2:20 PM – 3:20 PM, and
Mondays, 9:15 AM – 10 AM, in 226 Reber Building;
and by appointment.

Text:

Stephen R. Turns, "Thermodynamics: Concepts and Applications ,"

(first edition, Cambridge University Press, New York, 2006) ISBN: 0-521-85042-8.

Objectives: To understand the fundamental principles of thermodynamics in the context of the first and second laws and to apply these principles to solving problems. For objectives and outcomes applied specifically to the baccalaureate program in mechanical engineering, see Appendix 1.

Course requirements:

The course grade is based on the outcomes of homework, examinations, and quizzes.

First mid-term examination 15%

Second mid-term examination 20%

Third mid-term examination 20%

Final examination 25%

Homework 20%

Teaching assistants will grade the homework.

You may collaborate with your peers on the homework assignments.

The examinations will be announced in advance.

Academic dishonesty will not be tolerated, and sanctions will be imposed, which could result in a final grade of "F. If you have any questions about what constitutes academic dishonesty, ask your instructor for clarification.

Graduate Teaching Assistant- Section 1

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Course web site:

http://www.psu.edu/courses/m_e/m_e30_g9c/

Homework Format:

You must prepare all homework assignments using the following format. If you fail to follow the format, you will receive no credit.

1. Place the solution to each problem on one side of a separate page. (For Assignment 1, you may include more than one solution on a single page.)

2. Write neatly on only one side of the page, and do not include preliminary "scratch" work

3. Present your solution as a methodical sequence of equations and comments.

4. Where appropriate, include a schematic sketch.

5. Include the equations that you will evaluate numerically.

6. When evaluating numerical expressions, you must include **all units** in **each** step of a calculation.

7. Neatly staple the pages together, before you turn in the assignment.

8. To receive full credit, you must turn in the assignment on time.

Mechanical Engineering 300 – Engineering Thermodynamics I, Spring Semester 2008

Date	Class	Topics	Reading Assignments*	Homework Due**
Jan. 14	1	Organization of the course; definition of thermodynamics	Chapter 1; pp. 5-29	
16	2	Equilibrium, systems, properties, dimensions, units		
18	3	Zeroth law of thermodynamics, temperature scales		
21	4	no class		
23	5	Pressure; barameters and manometers	Chapter 2; pp. 40-51	
25	6	Archimedes' principle and additional examples		Homework 1
28	7	Homogeneous and heterogeneous systems; solutions and components		
30	8	Functions of state; internal energy, enthalpy	Chapter 3; pp. 52-135	
Feb. 1	9	Phase transitions for pure substances; property tables		
4	10	Property tables continued		
6	11	Equations of state; ideal gas		Homework 2
8	12	Ideal gas continued; heat capacities		
11	13	Real gases, compressibility factor		
13	14	Review		
15	15	Energy transfer by heat and work; moving-boundary processes	Chapter 4; pp. 218-248	Homework 3
18	16	Quasi-static, reversible, and irreversible processes		Exam 1
20	17	Isothermal, isobaric, and adiabatic processes		
22	18	First Law of thermodynamics for closed systems		
25	19	Shaft work and spring work		
27	20	Conservation of mass, flow work		
29	21	First Law for open systems; steady-flow systems	Chapter 3; pp. 162-193	
Mar. 3	22	Nozzles and diffusers, turbines and compressors		
5	23	Joule-Thomson effect, throttling valves and isenthalpic devices	Chapter 5; pp. 282-324	Homework 4

7	24	Mixing chambers, pipe and duct flow	Chapter 7; pp. 430-441	
		Spring Break, March 10 - 14		
17	25	Non-steady-flow processes	Chapter 7; pp. 463-494	
19	26	Review		Homework 5
21	27			Exam 2
24	28	Second Law of thermodynamics, Kelvin-Planck & Clausius statements	Chapter 6; pp. 344-382	
26	29	Heat engines, vapor-compression cycle, refrigerators, heat pumps		
28	30	Reversibility and Carnot cycle; entropy as a measure of irreversibility		
31	31	Statistical definition and interpretation of entropy		
Apr. 2	32	Entropy, the Second Law, and the principle of entropy increase		
4	33	Examples of calculations of entropy changes		
7	34	Combined First and Second Laws		
9	35	Additional examples of calculations of entropy changes		Homework 6
11	36	Reversible steady-flow work		
14	37	Isentropic processes; entropy generation		
16	38	Review		
18	39			Exam 3
21	40			Homework 7
23	41	Ideal Rankine cycle		
25	42	Analysis of thermodynamic systems		
28	43	Other cycles	Chapter 8; pp. 520-528	
30	44	Other cycles continued		
May 2	45	Review		
				Exam 4

*Additional reading may be assigned.

Dates for examinations and for submitting homework assignments are **tentative.

When an examination is held in the evening, a class period will be cancelled.

Spring Break: March 10 - 14, 2008

Appendix 1: Objectives and Outcomes for ABET, Inc., formerly, Accreditation Board for Engineering and Technology

Objectives

A. Appreciate the role of thermodynamics in engineering and society.

B. Understand the importance of thermodynamic properties and know how to use them.

C. Understand the First Law of Thermodynamics and know how to use it to solve engineering problems.

D. Understand the Second Law of Thermodynamics and know how to use it to solve engineering problems.

E. Apply the First and Second Laws to practical systems, including Rankine cycles, refrigeration cycles and gas cycles.

F. Develop fundamental, engineering problem-solving skills.

Learning Outcomes

1. Obtain thermodynamic data necessary to solve thermodynamic problems and when necessary use appropriate approximations. These skills include the use of equations of state and tabulated property tables. [B]

2. Write the First Law of Thermodynamics in the appropriate forms for both closed systems and for control volumes. [C]

3. Solve problems requiring First-Law analysis that produce a simple single answer. [C]

4. Make appropriate assumptions, when applying the First Law to a "real-world" problem. [C]

5. Write the Second Law of Thermodynamics in the appropriate forms for both closed systems and control volumes. [D]

6. Apply the Second Law to determine the performance limitations of a given thermodynamic system. [D]

7. Apply thermodynamic concepts to describe the performance of the individual components of an engineering system, e.g. a power plant, a jet engine, etc., and then relate that information to the overall performance of the entire system. [E]

8. Physically interpret and apply integrals and derivatives to solve thermodynamic problems. [F]

9. Translate complex word problems into an orderly and logical problem solving approach. [F]

10. Use software to solve thermodynamics problems. [F]